

WHAT IS CLAIMED IS:

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1. A method of recognizing a document image including a plurality of areas, comprising the steps of:

a) inputting said document image as a digital image;

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b) specifying a background color of said document image;

c) extracting a plurality of pixels located in areas other than a background area from said document image by use of said background color;

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d) creating a plurality of connected elements by combining said plurality of pixels; and

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e) classifying said plurality of connected elements into a plurality of fixed types of areas by using at least features of shapes of said plurality of connected elements to obtain an area-separated document image.

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2. The method as claimed in claim 1, further comprising the steps of:

f) creating a binary image by binarizing said area-separated document image;

5 g) classifying a plurality of areas included in said binary image into said plurality of fixed types of areas;

h) comparing a result of the step (e) and a result of the step (g);

10 i) correcting said area-separated document image if said result of the step (e) is not equal to said result of the step (g); and

j) recognizing a character in a text area of said area-separated document image.

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3. The method as claimed in claim 1, wherein  
20 said step (b) includes the steps of:

k) clustering a plurality of colors on said document image; and

l) setting a representative color of a largest cluster obtained by the step (k) to said background  
25 color.

4. The method as claimed in claim 3, wherein said step (k) includes the steps of:

sampling each of the plurality of pixels at regular intervals; and

5 clustering the plurality of colors on said document image by use of a plurality of pixel values obtained by smoothing pixels surrounding said each of the plurality of pixels.

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5. The method as claimed in claim 1, further comprising the step of reducing a size of said document image, wherein said step of reducing the size of said document image includes the steps of:

15 diving said document image into a plurality of blocks;

obtaining a representative color of each of said plurality of blocks;

20 determining colors of said plurality of blocks after sizes of said plurality of blocks are reduced, by comparing said representative color and said background color; and

25 reducing said plurality of blocks into the

plurality of pixels having said colors.

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6. The method as claimed in claim 5, wherein said each of the plurality of blocks is a  $3 \times 3$  or  $4 \times 4$  grating.

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7. The method as claimed in claim 1, wherein said step (c) includes the step of determining a focused pixel as a pixel located in an area other than said background area if a difference between three primary colors of said background color and said focused pixel is larger than a fixed value.

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8. The method as claimed in claim 1, further comprising the steps of:  
25 creating the document image, in which a figure

or photograph rectangular area separated by said step

(e) is painted over with a specified color;

binarizing said document image; and

recognizing characters on a binary image

5 obtained by binarizing said document image.

10 9. The method as claimed in claim 1, further  
comprising the step of recursively performing said step  
(e) to a specific rectangular area classified at said  
step (e).

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10. A method of recognizing a document image,  
comprising the steps of:

20 a) inputting said document image as a digital  
image;

b) performing color area separation to said  
document image;

c) creating a binary image for each area  
25 separated by said color area separation;

d) creating a single binary image by combining said binary image for each area, thereby performing binarization to said document image;

e) performing binary area separation to said  
5 single binary image;

f) comparing a result of said color area separation and a result of said binary area separation; and

g) obtaining a binary image and a result of  
10 area separation by performing a feedback process until a certain condition is satisfied, or for a fixed times, in accordance with a result of the step (f).

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11. The method as claimed in claim 10,  
wherein said feedback process is performed in a case in which the certain condition is not satisfied in a range  
20 of said document image as the result of the step (f),  
said feedback process including the steps of:

creating an area that includes said range;  
performing said color area separation, said binarization and said binary area separation to said  
25 area; and

performing said step (f).

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12. The method as claimed in claim 10,  
wherein said feedback process is performed in a case in  
which a text line is extracted from a range in said  
document image by one of said color area separation and  
10 said binary area separation, and a character rectangle  
including characters is not extracted from said range by  
the other, said feedback process including the steps of:  
specifying a character color of said character

rectangle;  
15 determining that said range includes a  
character if said character color is even throughout  
said range;

performing said color area separation, said  
binarization, said binary area separation to said range  
20 by use of said character color; and  
performing said step (f).

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13. The method as claimed in claim 12,  
wherein said feedback process includes the steps of:

creating an area including the text line in a  
case in which said text line extracted from the range by  
5 said color area separation does not exist in the result  
of the binary area separation as the result of said step  
(f);

performing said binarization and said binary  
area separation to said area; and

10 performing said step (f).

15 14. The method as claimed in claim 10,  
wherein said feedback process is performed in a case in  
which layout features of a fixed number or more than the  
fixed number of text lines are continuously different  
between said result of the color area separation and  
20 said result of the binary area separation as the result  
of said step (f), said feedback process including the  
steps of:

creating an area including said text lines;

binarizing said area;

25 performing said binary area separation to said



area; and

performing said step (f).

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15. The method as claimed in claim 10,  
wherein an image-division-type binarizing method is  
applied to a text area of said document image, and a  
10 discriminant analysis method is applied to ruled-line,  
figure, and photograph areas.

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16. The method as claimed in claim 10,  
wherein said color area separation includes the steps  
of:

specifying a background color of said document  
20 image;

extracting a plurality of pixels located  
outside a background area from said document image by  
use of said background color;

creating a plurality of connected elements by  
25 combining said plurality of pixels; and

classifying said plurality of connected elements into a plurality of fixed types of areas by use of at least features of shapes of said connected elements to obtain an area-separated document image.

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17. A document-image recognition device
- 10 recognizing a document image including a plurality of areas, comprising:
- an input unit inputting said document image as a digital image;
  - a background-color specifying unit specifying

15 a background color of said document image;

  - an extracting unit extracting a plurality of pixels located outside a background area from said document image by use of said background color;
  - a creating unit creating a plurality of

20 connected elements by combining said plurality of pixels; and

  - a classifying unit classifying said plurality of connected elements into a plurality of fixed types of areas by use of at least features of shapes of said

25 connected elements to obtain an area-separated document

image.

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18. The document-image recognition device as claimed in claim 17, further comprising:

a binary-image creating unit creating a binary image by binarizing said area-separated document image;  
10 a correcting unit classifying a plurality of areas included in said binary image into said plurality of fixed types of areas, and correcting said area-separated document image by comparing said area-separated document image with a result of classifying  
15 the plurality of areas; and

a recognizing unit recognizing a character in a text area of said document image.

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19. The document-image recognition device as claimed in claim 17, wherein said background-color specifying unit includes:

25 a clustering unit clustering a plurality of

colors on said document image; and

a setting unit setting a representative color  
of a largest cluster obtained by clustering said  
plurality of colors on said document image to said  
5 background color.

10 20. The document-image recognition device as  
claimed in claim 19, wherein said clustering unit  
includes:

a sampling unit sampling the plurality of  
pixels at regular intervals; and

15 a cluster unit clustering the plurality of  
colors on said document image by use of a plurality of  
pixel values obtained by smoothing pixels surrounding  
said plurality of pixels.

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21. The document-image recognition device as  
claimed in claim 17, further comprising a reducing unit  
25 reducing a size of said document image, wherein said

reducing unit includes:

a dividing unit dividing said document image  
into a plurality of blocks;

a representative-color obtaining unit  
5 obtaining a representative color of each of said  
plurality of blocks;

a color determining unit determining colors of  
said plurality of blocks after sizes of said plurality  
of blocks are reduced, by comparing said representative  
10 color and said background color; and

a block reducing unit reducing said plurality  
of blocks into the plurality of pixels having said  
colors.

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22. The document-image recognition device as  
claimed in claim 21, wherein each of said plurality of  
20 blocks is a 3×3 or 4×4 grating.

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23. The document-image recognition device as

claimed in claim 17, wherein said extracting unit  
includes a pixel determining unit determining a focused  
pixel as a pixel located outside said background area if  
a difference between three primary colors of said  
5 background color and said focused pixel is larger than a  
fixed value.

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24. The document-image recognition device as  
claimed in claim 17, further comprising:

a document-image creating unit creating the  
document image, in which a figure or photograph  
15 rectangular area separated by said classifying unit is  
painted over with a specified color;

a binarizing unit binarizing said document  
image; and

a character recognizing unit recognizing  
20 characters on a binary image obtained by binarizing said  
document image.

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25. The document-image recognition device as claimed in claim 17, recursively carrying out a process performed by said classifying unit to a specific rectangular area classified by said classifying unit.

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26. A document-image recognition device  
10 recognizing a document image, comprising:  
an input unit inputting said document image as a digital image;  
a color area separation unit performing color area separation to said document image;  
15 a binary-image creating unit creating a binary image for each area separated by said color area separation;  
a binary area separation unit creating a single binary image by combining said binary image for  
20 each area, thereby performing binarization to said document image, and performing binary area separation to said single binary image;  
a comparing unit comparing a result of said color area separation and a result of said binary area  
25 separation; and

an obtaining unit obtaining a binary image and  
a result of area separation by performing a feedback  
process until a certain condition is satisfied, or for a  
fixed times, in accordance with a result of comparison  
5 carried out by said comparing unit.

10 27. The document-image recognition device as  
claimed in claim 26, wherein said feedback process is  
performed in a case in which a text line is extracted  
from a range in said document image by one of said color  
area separation and said binary area separation, and a  
15 character rectangle including characters is not  
extracted from said range by the other, said feedback  
process including the steps of:

specifying a character color of said character  
rectangle;

20 determining that said range includes a  
character if said character color is even throughout  
said range;

performing said color area separation, said  
binarization, said binary area separation to said range  
25 by use of said character color; and



performing said comparison.

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28. The document-image recognition device as claimed in claim 27, wherein said feedback process includes the steps of:

10       creating an area including the text line in a case in which said text line extracted from the range by said color area separation does not exist in the result of the binary area separation as the result of said comparison;

15       performing said binarization and said binary area separation to said area; and

      performing said comparison.

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29. The document-image recognition device as claimed in claim 26, wherein said feedback process is performed in a case in which layout features of a fixed number or more than the fixed number of text lines are  
25       continuously different between said result of the color

area separation and said result of the binary area separation as the result of said comparison, said feedback process including the steps of:

- 5           creating an area including said text lines;
- binarizing said area;
- performing said binary area separation to said area; and
- performing said comparison.

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30. A record medium readable by a computer, tangibly embodying a program of instructions executable  
15 by the computer to carry out a document-image recognition process, said instructions comprising the steps of:

- a) inputting said document image as a digital image;
- 20          b) specifying a background color of said document image;
- c) extracting a plurality of pixels located outside a background area from said document image by use of said background color;
- 25          d) creating a plurality of connected elements

by combining said plurality of pixels; and

- e) classifying said plurality of connected elements into a plurality of fixed types of areas by use of at least features of shapes of said connected elements to obtain an area-separated document image.

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- f) creating a binary image by binarizing said area-separated document image;

- g) classifying a plurality of areas included in said binary image into said plurality of fixed types of areas;

- h) comparing a result of the step (e) and a result of the step (g);

- i) correcting said area-separated document image if said result of the step (e) is not equal to said result of the step (g); and

- j) recognizing a character in a text area of said area-separated document image.

32. A record medium readable by a computer, tangibly embodying a program of instructions executable by the computer to carry out a document-image recognition process, said instructions comprising the steps of:

a) inputting said document image as a digital image;

b) performing color area separation to said document image;

10 c) creating a binary image for each area separated by said color area separation;

d) creating a single binary image by combining said binary image for each area, thereby performing binarization to said document image;

15 e) performing binary area separation to said single binary image;

f) comparing a result of said color area separation and a result of said binary area separation; and

20 g) obtaining a binary image and a result of area separation by performing a feedback process until a certain condition is satisfied, or for a fixed times, in accordance with a result of the step (f).